

Appendix D: Corrective Action Monitoring Plan :

James City County Sanitary Landfills Nos. 96 and 351

PREPARED FOR:
JAMES CITY COUNTY
1204 JOLLY POND ROAD
WILLIAMSBURG, VIRGINIA 23188

**JAMES CITY COUNTY SANITARY LANDFILL
PERMIT NOS. 96 AND 351**

**CORRECTIVE ACTION MONITORING PLAN
(REVISED)**

JUNE 2008

PREPARED BY:



1604 OWNBY LANE
RICHMOND, VIRGINIA 23220
PHONE: 804.355.4520
FAX: 804.355.4282
JEI PROJECT NO. 431.01 TASK NO. 26

CORRECTIVE ACTION MONITORING PLAN (REVISED)
James City County Sanitary Landfill
Permit Nos. 96 and 351

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DRAWING

Drawing 1 Monitoring Network

1.0 INTRODUCTION

James City County has prepared this revised *Corrective Action Monitoring Plan* (Revised CAMP) in accordance with 9VAC20-80-310.A.2 and 9VAC20-80-310.C.1.a of the Virginia Solid Waste Management Regulations (VSWMR). This revised CAMP will serve as the guidance document for collecting and analyzing samples to evaluate the effectiveness of corrective measures implemented at the James City County Sanitary Landfill in James City County, Virginia, during the course of the Corrective Action Program. This revised CAMP is a supplement to, but does not replace, the existing *Groundwater Monitoring Plan*. It replaces the original CAMP dated December 2006 that was included as Appendix IV of the original Corrective Action Plan (CAP), also of the same date.

The Nature and Extent Study (NES) dated October 11, 2002, delineated two groundwater contaminant plumes at the James City County Sanitary Landfill: the eastern plume and the western plume. The eastern plume extends beyond the landfill property boundary onto other James City County-owned property. The revised *Corrective Action Plan* (Revised CAP), dated June 2008, includes the use of Monitored Natural Attenuation (MNA) to reduce on-site and/or future off-site constituent-of-concern concentrations detected in both plumes to below established Groundwater Protection Standards (GPS). On-site and off-site concentrations will be determined by periodically monitoring compliance, performance, and sentinel monitoring wells. This CAMP describes the monitoring network associated with the groundwater plume and is an integral component of the corrective action remedies, ensuring performance factors are being met and determining whether contingency measures need to be addressed.

This Revised CAMP will be implemented during the Corrective Action Program until constituents detected in groundwater are below the GPS within the plume for three consecutive years. The post-closure care period, which began in 1995, will be extended until such time as GPS are not exceeded for three consecutive years.

2.0 MONITORING NETWORK

During the Corrective Action Program, the County will continue to perform groundwater monitoring in accordance with the Phase II Monitoring Program. In addition, during the Corrective Action Program, the monitoring presented in this Revised CAMP will be performed. The Revised CAMP for the James City County Sanitary Landfill will be implemented concurrently with the compliance monitoring program that is outlined in the facility's operating permit. Data obtained during the routine compliance monitoring program will be used to evaluate the performance of the MNA remedy proposed in the Revised CAP. In addition to the compliance network, additional wells to support the Corrective Action monitoring network will be installed to monitor the remediation method employed within 90 days of CAP permit issuance.

A discussion on the monitoring activities to be performed as part of the Corrective Action remedy follows. Groundwater monitoring activities to evaluate the performance of MNA on

impacted groundwater east and west of the facility's waste management unit boundary beneath facility and County-owned properties consists of existing compliance and proposed performance and sentinel wells. Existing sentinel wells will be used where possible. The locations of the monitoring network wells discussed in the following sections are shown on Drawing 1.

2.1 Monitoring Network Summary

Consistent with US Environmental Protection Agency (USEPA) and DEQ guidance (DEQ, 2004), a monitoring well network composed of compliance, performance, and sentinel wells will be used to adequately monitor the effectiveness of MNA. Each compliance well that has shown GPS-exceeding constituents will have a corresponding performance well located downgradient an approximate 5-year groundwater travel time distance, and along the same groundwater flow path. Likewise, each compliance/performance well pair will have a corresponding sentinel well located between the downgradient receptor and the compliance/performance well pair. The following table summarizes the MNA well network:

GPS-Exceeding Compliance Well ID	GPS Constituents of Concern	Associated MNA Performance Well	Associated MNA Sentinel Well
MW-3	Zinc, Benzene, Vinyl Chloride	MW-36	MW-37
MW-4	Arsenic, Chloroethane	MW-40	NES-1
MW-5	Tetrachloroethene	MW-41	NES-2
MW-6	Chloroethane	MW-42	MW-43
MW-7	Chloroethane, Tetrachloroethene, Trichloroethene, Vinyl Chloride	MW-45	NES-4
MW-8	Arsenic, Benzene, Chloroethane, Tetrachloroethene, Trichloroethene, Vinyl Chloride	MW-48	NES-5
MW-25	Chloroethane	MW-38	MW-39
MW-33	Benzene, Chloroethane, Tetrachloroethene, Trichloroethene, Vinyl Chloride	MW-44	SW-1
MW-34	Benzene; cis-1,2-Dichloroethene; Tetrachloroethene, Trichloroethene, Vinyl Chloride	MW-46	MW-47
MW-35	Dichloromethane, Tetrachloroethene, Vinyl Chloride	MW-49	NES-5

The proposed performance and sentinel wells not yet existing will be installed within 90 days of CAP permit issuance. The existing compliance wells and proposed performance and sentinel wells are illustrated on Drawing 1.

Monitoring wells MW-7, MW-8, MW-24, MW-33, MW-34, and MW-35 will be retained as compliance wells. Monitoring well MW-24 is the facility's upgradient monitoring well.

2.2 Monitoring Network Sampling Constituents and Frequency

Samples collected from these wells will be obtained in accordance with the procedures discussed in the facility's Groundwater Monitoring Plan. The following table presents the monitoring frequency for each of the sampling locations contained in the compliance, eastern plume, and western plume monitoring networks:

Sampling Location	Monitoring Network	Sampling Frequency	Constituent List
MW-2	Compliance (Eastern)	Semi-annually	Phase II
MW-3	Compliance (Western)	Semi-annually	Phase II/MNA Indicator Parameters
MW-4	Compliance (Western)	Semi-annually	Phase II/MNA Indicator Parameters
MW-5	Compliance (Western)	Semi-annually	Phase II/MNA Indicator Parameters
MW-6	Compliance (Western)	Semi-annually	Phase II/MNA Indicator Parameters
MW-7	Compliance (Eastern)	Semi-annually	Phase II/MNA Indicator Parameters
MW-8	Compliance (Eastern)	Semi-annually	Phase II/MNA Indicator Parameters
MW-24	Compliance	Semi-annually	Phase II
MW-25	Compliance (Western)	Semi-annually	Phase II/MNA Indicator Parameters
MW-26	Compliance (Western)	Semi-annually	Phase II
MW-33	Compliance (Eastern)	Semi-annually	Phase II/MNA Indicator Parameters
MW-34	Compliance (Eastern)	Semi-annually	Phase II/MNA Indicator Parameters
MW-35	Compliance (Eastern)	Semi-annually	Phase II/MNA Indicator Parameters
MW-36	Performance (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-37	Sentinel (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-38	Performance (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-39	Sentinel (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-40	Performance (Western)	Semi-annually	Western C-O-C/MNA

Sampling Location	Monitoring Network	Sampling Frequency	Constituent List
			Indicator Parameters
MW-41	Performance (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-42	Performance (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-43	Sentinel (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
MW-44	Performance (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
MW-45	Performance (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
MW-46	Performance (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
MW-47	Sentinel (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
MW-48	Performance (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
MW-49	Performance (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
NES-1	Sentinel (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
NES-2	Sentinel (Western)	Semi-annually	Western C-O-C/MNA Indicator Parameters
NES-4	Sentinel (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
NES-5	Sentinel (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters
SW-1	Sentinel (Eastern)	Semi-annually	Eastern C-O-C/MNA Indicator Parameters

Phase II = Phase II Monitoring Program parameters

MNA Indicator Parameters = dissolved oxygen, specific conductance, temperature, alkalinity, redox, chloride, nitrate, nitrite, ferrous iron, sulfate, sulfide, and ethane

Eastern C-O-C = VSWMR Table 5.5 VOCs (EPA SW-846 Method 8260) and arsenic

Western C-O-C = VSWMR Table 5.5 VOCs (EPA SW-846 Method 8260), arsenic, and zinc

The semi-annual sampling frequency for monitoring MNA is based on the slow groundwater flow velocity measured at the site and relative stability of the groundwater plume.

3.0 STATISTICAL GPS COMPARISON METHODOLOGY

Constituents-of-concern detected in the samples collected from the sentinel locations shall be compared to the GPS established for the facility using one of the following methods. If

the GPS is derived from facility background concentrations, then the data must be compared directly to GPS using a value-to-value comparison. If the established GPS is derived from a DEQ-established Alternate Concentration Limit (ACL) or EPA-established Maximum Contaminant Level (MCL), then the monitoring data may be compared to the GPS statistically and/or using a value-to-value procedure.

The comparison will initially be performed using a value-to-value procedure. If a suspect GPS exceedance is noted during the value-to-value comparison, a confirmation sample may be collected. The results from the confirmation sample will be compared to the GPS in a value-to-value comparison. If the comparison indicates a GPS exceedance, the source of the GPS will be determined. If the GPS is derived from an ACL or MCL, James City County may elect to collect two additional samples for the suspect constituent(s) in order to perform a statistical comparison to the GPS. It is noted that confirmation sampling and/or additional sampling required to perform a statistical evaluation must occur within 90 days of the initial sampling event, during which a suspect GPS exceedance was identified.

To perform a statistical comparison, a minimum of four samples must be collected within the specified 90-day period. Once data have been received for the four samples, a lower confidence limit should be calculated and compared to the GPS. The lower limit should be calculated initially by using a 95% confidence level. The procedure for evaluating the data is as follows:

- Calculate the mean, \bar{x} , of the four samples;
- Calculate the standard deviation of the sample;
- Determine the critical value, t_c , for a confidence level of 90% (5% on each tail) and degrees of freedom, $d.f. = n-1$;
- Calculate E , where $E = (t_c) * (s / (n)^{0.5})$;
- Calculate the lower 5% Confidence Interval, $L_{0.05}CI$, where $L_{0.05}CI = (\bar{x} - E)$; and
- Compare the $L_{0.05}CI$ to the GPS.

If the $L_{0.05}CI$ is less than the GPS, there is no statistically significant increase in the mean of the data. If the lower limit exceeds the GPS, the DEQ may be contacted regarding the use of a confidence level greater than 95%.

4.0 MNA PERFORMANCE EVALUATION

Performance evaluation of the MNA remedy will be based on trend evaluations of contaminant concentrations, MNA parameters, and plume areal extent. Data obtained from the nine sentinel wells will be used to annually re-evaluate the risk posed by the residual plume. In the event that contaminant concentrations in the sentinel wells exceed GPS and are confirmed by confirmation sampling within 30 days, James City County will install additional sentinel wells, as needed, between the existing sentinel wells and the receptors of interest. Analytical data obtained from the sentinel wells will be used to re-evaluate the risk from the plume.

In the event that risk to human health or the environment is unacceptable, then alternative

remedial methods as discussed in the Revised CAP will be implemented (e.g., enhanced bioremediation may be implemented to accelerate the rate of contaminant attenuation/mitigation). Once contaminant concentrations in the sentinel wells are below established GPS, then this portion of the remedy will be complete.

The MNA remedy will be evaluated based on analytical results obtained from the performance wells listed in Section 2.1 above. Data obtained from these wells will be tracked using concentration trend graphs and Mann-Kendall statistics to evaluate the effectiveness of the MNA remedy.

To evaluate the need for implementation of an alternative remedy, an evaluation of the analytical results for the semi-annual monitoring of the sentinel wells will be performed. Analytical results obtained from the routine monitoring of the sentinel wells will be used to determine if constituents-of-concern may be present off site in concentrations that exceed GPS. The analytical results will be compared to the GPS using a value-to-value comparison method or a statistical comparison method as detailed in Section 3.0.

If constituent-of-concern concentrations are observed to be less than the established GPS in sentinel wells, no action will be required, and the routine compliance and corrective action monitoring will continue until the remedial objective is achieved and the Corrective Action Program is suspended.

If constituent-of-concern concentrations are confirmed to exceed the GPS in the sentinel wells, the MNA monitoring network will be expanded or an appropriate alternative and/or supplemental remedy will be implemented in the affected area. The affected area is defined as the area in the immediate vicinity of the affected wells, not to exceed one-half of the distance to the sentinel wells on either side of the affected sentinel well. James City County may elect to conduct a confirmation sampling event within 30 business days of the date on the laboratory certificates-of-analysis if the laboratory data are suspected to be inaccurate.

If required, based on the results obtained from the routine monitoring of the sentinel wells, James City County will implement an alternative remedy (e.g, enhanced bioremediation may be implemented to accelerate the rate of contaminant attenuation/mitigation) no more than 90 days after the GPS exceedance is confirmed and DEQ approval of an appropriate alternative remedy is granted. After the alternative remedy is implemented, samples will be obtained from the affected sample location(s) within 90 days to confirm the remedy is working as designed. The performance criteria will consist of a value-to-value comparison of the analytical data from the affected well(s) to the GPS.

If the comparison indicates that the concentrations of the constituents-of-concern have been reduced to less than the GPS, the alternative remedy will be considered complete, and the routine MNA monitoring will resume until the Corrective Action Program is suspended.

If the comparison indicates that the constituents-of-concern are still present at concentrations that exceed the GPS, sampling of the affected sentinel well(s) will be conducted

approximately every 90 days (i.e., on a quarterly basis) until the constituent-of-concern concentrations are below the GPS. If, after five alternative remedy monitoring events, the constituents-of-concern are still present at concentrations that exceed the GPS, a re-evaluation of the alternative remedy and an appropriate adjustment or alteration of the remedy will be implemented within 90 days of the fifth alternative remedy sampling event. The alternative remedy implementation and confirmation sampling will continue as specified above until the constituent-of-concern concentrations decrease to less than the GPS in the affected sentinel well(s), unless the County is otherwise directed by DEQ.

5.0 CORRECTIVE ACTION PROGRAM REPORTING

The performance criteria for the MNA remedy will be evaluated at least annually and the evaluation results will be presented to the DEQ once every 5 years in a Corrective Action Site Evaluation (CASE) Report, on the anniversary date of the CAP permit amendment. The CASE Report will provide recommended modifications to the CAP, if appropriate.

The CASE Reports will be available for public review at the following public data repositories:

Virginia Department of Environmental Quality Central Office 629 East Main Street Richmond, Virginia	Contact: Geoff Christe Groundwater Program Coordinator 804-698-4283
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Virginia Department of Environmental Quality Tidewater Regional Office 5636 Southern Blvd. Virginia Beach, Va. 23462	Contact: Milt Johnston Waste Compliance Manager 757-518-2151
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James City County Public Library 7770 Croaker Road Williamsburg, Va 23188	Contact: Jennifer Kuncken Adult Services Librarian 757-259-7770
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In the event that a suspect GPS exceedance is identified in one or more sentinel monitoring samples based on routine MNA remedy monitoring results pursuant to the Revised CAMP, James City County will notify the DEQ in writing of:

- the suspected exceedance within 14 days of the date on the laboratory certificates-of-analysis; and
- James City County's intended course of action to address the suspect GPS exceedance.

James City County may choose to conduct a confirmation sampling event within 30 business days of the date on the laboratory certificates-of-analysis if the laboratory data are suspected to be inaccurate. Alternatively, James City County may implement an appropriate

alternative remedy contingent upon DEQ approval.

If James City County elects to perform a confirmation sampling event, James City County will notify the DEQ in writing of the sampling results within 14 days of the date on the laboratory certificates-of-analysis for the confirmation sample. If the initial results are confirmed, the notification will identify future actions that James City County intends to implement. Possible actions are:

- Collection of additional samples as required to perform a statistical comparison of the analytical results to the GPS in accordance with the procedures in Section 3.0
- A plan of action for implementing an alternative remedy to address the suspect GPS exceedance.

If the suspect GPS exceedance is refuted by the confirmation sampling event, James City County will notify the DEQ of this finding and of the County's intent to continue the routine MNA remedy monitoring program presented in the Revised CAMP.

If the initial results are confirmed by the confirmation sampling event and James City County elects to perform a statistical comparison to the GPS, James City County will collect the required additional samples within 90 days of the date of the initial sample. Results of the statistical comparison will be submitted in writing to DEQ within 14 days of the date on the laboratory certificates-of-analysis for the final sample collected for the statistical comparison.

If the suspect GPS exceedance is refuted by the statistical comparison, the notification will present this finding and inform the DEQ of the County's intent to continue the routine MNA remedy monitoring program presented in the Revised CAMP.

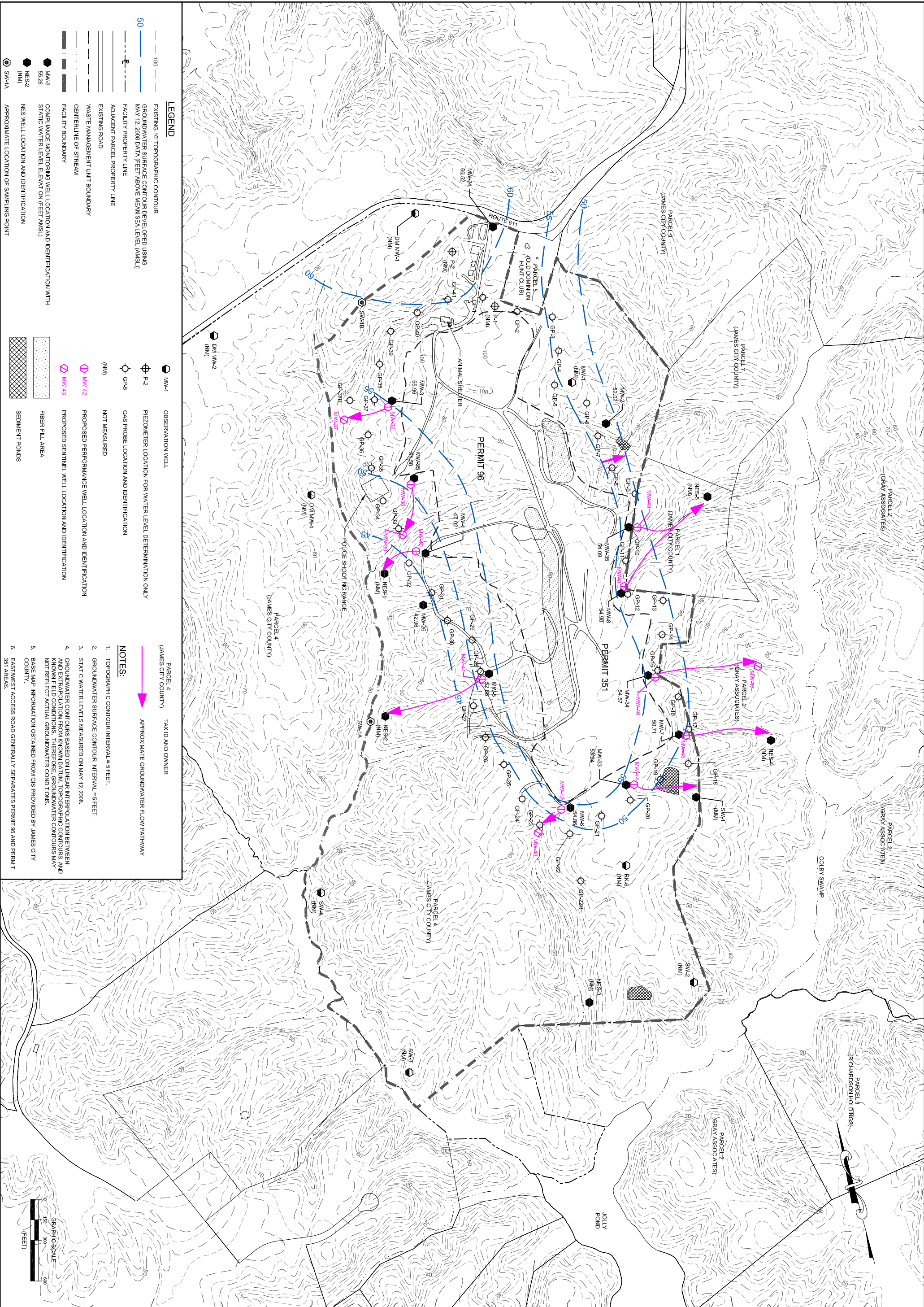
If the suspected GPS exceedance is confirmed by the statistical comparison, the notification will present this finding and inform the DEQ of the County's intent to implement an alternative remedy within 90 days of the date of the confirmation notification and DEQ approval of the alternative remedy.

If the alternative remedy is implemented, James City County will notify the DEQ in writing of analytical results within 14 days of the date on the certificates-of-analysis for required sampling activities. The notifications will also state any additional activities proposed by James City County based on the value-to-value comparison with the GPS.

After the remedial objectives of the Revised CAP have been obtained within each respective plume for the required time period, James City County will notify the DEQ of its intent to suspend the monitoring requirements of the Revised CAMP and of its intent to revert to a Phase II Monitoring Program as defined in the facility's Groundwater Monitoring Plan. For example, if the constituents detected in groundwater within the western plume are below GPS for three consecutive years, then monitoring of the western plume will stop; however, monitoring of the eastern plume will continue.

6.0 REFERENCES

- Joyce Engineering, Inc. (JEI). 2002. *Nature and Extent Study and Proposal for Presumptive Remedies*. November.
- JEI. 2003. *Proposal for Presumptive Remedies Addendum*. September.
- JEI. 2004. *Nature and Extent Study Addendum*. September 15.
- JEI. 2008. *Revised Corrective Action Plan*. June.
- United States Environmental Protection Agency. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. November.
- VDEQ (Virginia Department of Environmental Quality). 2004. Submission Instructions No. 21 Groundwater Monitoring Programs As Regulated Landfills Undergoing Monitored Natural Attenuation (MNA)-Based Corrective Action. April.
- VDEQ. Letter from Geoff Christe to Sanford B. Wanner, James City County. February 20, 2008.



LEGEND

EXISTING 10' TOPOGRAPHIC CONTOUR
GROUNDWATER SURFACE CONTOUR DEVELOPED USING
MAY 12, 2008 DATA (FEET ABOVE MEAN SEA LEVEL (AMSL))
FACILITY PROPERTY LINE
ADJACENT PARCEL PROPERTY LINE
EXISTING ROAD
WASTE MANAGEMENT UNIT BOUNDARY
CENTERLINE OF STREAM
FACILITY BOUNDARY
COMPLIANCE MONITORING WELL LOCATION AND IDENTIFICATION WITH
STATIC WATER LEVEL ELEVATION (FEET AMSL)
NES WELL LOCATION AND IDENTIFICATION
APPROXIMATE LOCATION OF SAMPLING POINT

MW-1 OBSERVATION WELL
P-2 PIEZOMETER LOCATION FOR WATER LEVEL DETERMINATION ONLY
GP-5 GAS PROBE LOCATION AND IDENTIFICATION
(NM)
NOT MEASURED
PROPOSED PERFORMANCE WELL LOCATION AND IDENTIFICATION
PROPOSED SENTINEL WELL LOCATION AND IDENTIFICATION
FIBER FILL AREA
SEDIMENT PONDS

PARCEL 4 (JAMES CITY COUNTY) TAX ID AND OWNER
APPROXIMATE GROUNDWATER FLOW PATHWAY

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 5 FEET.
2. GROUNDWATER SURFACE CONTOUR INTERVAL = 5 FEET.
3. STATIC WATER LEVELS MEASURED ON MAY 12, 2008.
4. GROUNDWATER CONTOURS BASED ON LINEAR INTERPOLATION BETWEEN
AND EXTRAPOLATION FROM KNOWN DATA. TOPOGRAPHIC CONTOURS, AND
KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY
NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
5. BASE MAP INFORMATION OBTAINED FROM GIS PROVIDED BY JAMES CITY
COUNTY.
6. EASTWEST ACCESS ROAD GENERALLY SEPARATES PERMIT 96 AND PERMIT
351 AREAS.